Program Overview

Science and Natural Resources

Pictured Rocks National Lakeshore

"The Service will try to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity, and genetic and ecological integrity of the plant and animal species native to those ecosystems.

"Natural systems in the national park system, and the human influences upon them, will be monitored to detect change. The Service will use the results of monitoring and research to understand the detected change and to develop appropriate management actions.

"Park managers must also take action to ensure that ongoing NPS activities do not cause the impairment of park natural resources. In cases of doubt as to the impacts of activities on park natural resources, the Service will decide in favor of protecting the natural resources."

NPS Management Policies (2001)

INTRODUCTION

The Science and Natural Resources (S&NR) program has progressed significantly during the last three years. With a staff of three permanent and a score of seasonal employees, the program has grown beyond developing the initial resource management plan and is conducting many research projects in-house. To clarify Science and Natural Resource goals, and to share this focus with staff and the public, we have condensed the program into this overview.

> "The National Park Service contributes to knowledge about natural and cultural resources and their associated values; management decisions about resources and visitors are based on adequate scholarly and scientific information." (Mission Goal Ib)

BIG QUESTIONS

The Lakeshore continues to grow through various developmental projects. New facilities are developed or upgraded, visitation impacts increase, yet our mission to protect the Lakeshore for future generations while permitting people to visit remains the same. We are required by law to quantify the impacts of these changes through National Environmental Policy Act (NEPA) and National Historic Preservation Act (NHPA) compliance and documentation as well as NPS policy and the Natural Resource Challenge. Larger issues loom on the horizon too; what is the balance between visitation and resource impacts and what level of resource degradation relative to visitor numbers and associated development are we willing to accept? None of these questions can be answered without knowing what suite of natural resources are here, and how they interact among themselves and with visitors to create the Pictured Rocks National Lakeshore we know.

FINDING THE ANSWERS

Direction for the current program is based in NPS Management Policies which calls for sound science and establishing a broad inventory and monitoring program. The information S&NR staff currently seek will answer basic questions of "what is out there, how the parts interact, and how people can impact and also learn from these natural resource interactions." Baseline data and program protocols need to be assessed and developed so that the entire program progresses.

THE "BIG THREE"

The *Natural Resource Challenge* identifies several critical groups of resources for data gathering, analysis and long term management. Among these are **terrestrial vertebrates**, **vegetation**, and **aquatic communities** which the Lakeshore has identified as suites of information lacking critical data. These groups are good indicators of ecosystem health. The current division structure reflects this Servicewide emphasis on these key ecosystem health data. Current research projects reflect the lack of baseline information on these resources.

MODELING and PREDICTING IMPACTS

As vegetation, aquatic, and terrestrial communities are inventoried and monitored, the data will be used to develop predictive models. For example, these models will be able to tell us "if species A is found in location B, we should anticipate that C and D are also there. In addition, if we introduce so many visitors E, we can expect that species B will decline by X%."

As information is gathered and models constructed, it should give park managers accurate, science based tools to make informed decisions. The following summaries provide a brief overview of current efforts to quantify critical park natural resources.

Peregrine falcon

AQUATIC INVENTORY AND MONITORING

The Lake Superior shoreline of Pictured Rocks National Lakeshore attracts many visitors. And yet, beneath the surface of the water in the quarter mile nearshore boundary of the Lakeshore is a fish community that has not been inventoried until this summer. The U.S. Fish and Wildlife Service from Ashland, Wisconsin, is conducting a study that will identify which species use nearshore habitats either permanently or during spawning runs. The study includes three, week-long sampling periods in 2002: May, July, and September/October. A variety of sampling methods are being used including gill nets, trap nets, seines, trawls, and electro-shocking at night from a boat and backpack shocking during the daytime at the mouths of major streams. They will submit a report of the nearshore fish of Lake Superior along Pictured Rocks National Lakeshore in September 2003.

Aquatic ecologist with sea lamprey

In addition to Lake Superior, there are diverse inland aquatic environments of the Lakeshore. The federally owned portion of the Lakeshore includes lakes with distinct qualities. Legion Lake is a clear, glacial kettle lake with no stream flowing in or out. Little Beaver and Miners Lakes are "brown water" lakes with considerable dissolved organic carbon. Chapel Lake is a very deep lake whose water does not turn over completely in spring and fall. Grand Sable Lake is a dune dammed lake. Some, like Beaver, Little Beaver, Trappers, and Miners Lakes, were former embayments of the great lake that became separated when water levels dropped and beach ridges separated them from what is today Lake Superior. They are several thousand years younger than the other lakes that formed as the glacier retreated from this area about 9,500 years ago. Differences in the origin and water quality of the lakes result in different aquatic communities of fish, zooplankton, algae, benthos

(bottom dwelling invertebrates), aquatic plants, and shoreline birds and amphibians.

The Lakeshore is charged with protecting these communities, and perhaps the greatest threat to them is the introduction of exotic species. Each month from May to October, staff from the science division monitor the lakes. We measure water clarity and share this information with Kent State University, where a large database from across North America is maintained. Water samples are taken from Beaver Lake and Grand Sable Lake, the two lakes with motorboat access, and examined for the presence of larval zebra mussels *(Dreissena polymorpha)*, quagga mussels *(Dreissena bugensis)*, and Asian clam, *(Musculista senhousia)*. Bricks secured near the boat launches are checked for the presence of adult zebra mussels. Water samples are taken to assess presence of non-native zooplankton including the spiny water flea *(Bythotrephes cederstoemi)*, fishhook water flea *(Circopagus pengoi)*, and Lumholtz's daphnia, *(Daphnia lumholtzi)*. These organisms can disturb the food web of native species, including game fish. We check for purple loosestrife, *(Lythrum salicaria)*, and Eurasian milfoil, *(Myriophyllum spicatum)*, along the shorelines of lakes and at stream road crossings. In addition to monitoring exotic species, we take measurements of water quality, including acidity, temperature, and dissolved oxygen throughout the water column of the inland lakes. These data are used to determine at what depth most small aquatic organisms are found in a particular lake and to compare the lake's stratification pattern to that of previous years. These patterns are the basis for measuring long-term climate change. Zooplankton and algae of the lakes will be identified over the winter and compared to previous studies that have examined these organisms since the establishment of the Lakeshore.

The discharge of several of the larger Lakeshore streams are monitored monthly. These data will be compared to measurements of snowpack and annual precipitation. This information is important to fisheries biologists who study movements of fish species from Lake Superior into rivers and streams during spring and fall spawning runs. One trend is clear; streams rise quickly immediately following a heavy rain or rapid snowmelt.

Near-shore fishery survey

We cooperate with the U.S. Fish and Wildlife Service (USFWS) Sea Lamprey Control Division to monitor sea lamprey, *(Petromyzon marinus)*, in Miners River during their spawning run, May through July. We use the Fish and Wildlife Service's mark and recapture methods to estimate the population of this non-native species. They incorporate this information into a mitigation program for the Lake Superior basin and the entire Great Lakes.

We continue to work with the USFWS in reintroducing native coaster brook trout, *(Salvelinus fontinalis),* to several streams of Pictured Rocks National Lakeshore. The eggs of coaster brook trout come from the Isle Royale National Park and are reared in a USFWS hatchery in Wisconsin. A fisheries biologist from the Ashland, Wisconsin, office of the USFWS visits several times a year to assess populations in the streams. He looks for fin clips to determine if brook trout are native or are reintroduced coasters, and length measures to determine growth and survival of various age classes.

Two research projects are currently being conducted on inland aquatic resources at Pictured Rocks National Lakeshore. A graduate student at Northern Michigan University's (NMU) Biology Department has been studying habitat availability for reintroduced coaster brook trout in selected Lakeshore streams. He

is measuring and describing water quality and is quantifying the food base for this native species. In studying the food base, he has measured respiration rates of algae and identified and counted aquatic invertebrates.

Another graduate student from the NMU Biology Department is assessing movements of fish in the Beaver Lake system. During spring and fall spawning runs, he sets traps and nets in Beaver Creek, Lowney Creek, Little Beaver Creek, and the channel between Little Beaver Lake and Beaver Lake to determine the timing and the species of fish migrating inland waters from Lake Superior.

An inventory of native clams (freshwater mussels) of Pictured Rocks National Lakeshore was completed by the U.S. Geological Survey from Ann Arbor, Michigan, last year. Although no rare or unusual species were found and not all lakes have freshwater mussels, some lakes have distinctly different species composition. Their successful reproduction depends on the presence of particular species of native fish that carry and incubate the larvae. The report of their findings was submitted to the Lakeshore this spring.

Much of the Lakeshore landscape is water or wetlands. The Natural Resource Challenge calls for the NPS to provide leadership for a healthy environment. "The protection of national park waters, watersheds, and aquatic life is fundamental to maintaining the integrity of natural resources and the quality of visitor experience in the parks. A consistent approach to identifying and measuring progress toward meeting water quality standards is essential. Protective standards, scientific monitoring, and a program to ensure the protection of water quality, natural flows, and a health of aquatic systems are required to protect this critical environmental component."

TERRESTRIAL VERTEBRATES

Mammals

In contrast to many units of the National Park Service, hunting is authorized within federally-owned lands at Pictured Rocks. In addition, trapping occurs within non-NPS owned lands in the Inland Buffer Zone. One Lakeshore mandate is to maintain viable populations of indigenous wildlife. Lakeshore biologists are cooperating with Michigan Department of Natural Resource (MDNR) personnel in documenting harvest of wildlife species within Pictured Rocks. Species with detailed harvest data include black bear, *(Ursus americana)*, fisher, *(Martes pennati)*, and American marten, *(Martes americana)*. Because of the linearity of Pictured Rocks and vulnerability of these species, potential for overharvest exists. Therefore, demographics data for these species is needed to determine whether current harvest levels are appropriate.

Fisher markings

Other types of human activity can affect these and other wildlife species. Examples at Pictured Rocks include logging in the Inland Buffer Zone; road, trail, and campground construction; and high levels of human visitation. For effective management and environmental compliance, scientific information on the ecology of various wildlife species is required.

Lakeshore biologists have recently initiated two multi-faceted mammal projects. One involves black bear, the other medium-sized forest carnivores focusing on American marten and fisher. Both projects involve capture and marking which occurs typically from late spring to early summer. Some individuals receive

radio transmitters and are monitored several times each week through autumn. Location information will be converted to digital data and used to estimate home range size and seasonal habitat preferences relative to human use/development. Using computer modeling and GIS, habitat suitability will be modeled for the entire lakeshore. These models will be used for predicting probability of species occurrence. Two important management issues can then be addressed. The first is assessing actual versus potential habitat available for each species. That is, how much habitat is lost or gained as a result of human presence. The second issue is to estimate loss of habitat from proposed development. In this case, management alternatives can be incorporated into GIS themes and the amount of habitat loss can be quantified for each alternative. This will be a beneficial tool for considering future visitor use and experience within the umbrella of maintaining natural resource integrity.

Documenting survival of these species is an important demographic parameter. Radio transmitters used in our studies include a mortality sensor that changes the pulse rate when the transmitter has not moved for a specified interval. Transmitters with mortality signals are located to determine the fate of the animal. We can estimate survival by comparing the number of animals alive to the number of animals that have died for pre-determined intervals to assess when significant changes in mortality occur. We can also estimate which mortality factors have the greatest effect on the population. To date, mortality factors have included hunting, trapping, and vehicle collision. For black bears, we are also assessing reproduction. Female bears are checked in dens during late winter to determine body condition and presence of young. This will provide information on age of first reproduction, litter size, and survival of dependent bears.

Black bear populations are estimated in the Upper Peninsula using a mark-recapture technique. Baits containing tetracycline are placed systematically in bear habitat throughout the Upper Peninsula. Lakeshore biologists assist MDNR personnel place these baits in Pictured Rocks. Bears that ingest baits are marked with tetracycline which is exhibited by a florescence in bone, typically from a tooth collected when the bear is harvested. The population estimate is calculated using the marked population (number of bears that ingest baits) and the recaptured population (number of bears harvested with the tetracycline marker). This technique works well for the Upper Peninsula because of the large number of bears harvested annually. This technique is not applicable for Pictured Rocks, however. We intend to use a mark-recapture estimator employing cameras at bait stations. In this case, the marked population will be the cohort of bears with eartags captured initially. The recaptured population will be the group of bears that have been photographed at the bait stations. We are also exploring the feasibility of using microsatellite analyses of DNA obtained from baited hair snaring devices as a means of estimating the population.

Weighing black bear

Lakeshore scientists also assist MDNR biologists by conducting winter track surveys of carnivores and snowshoe hare as part of an Upper Peninsula-wide project to establish population trends. As with black bear, the existing protocol will not provide suitable results for Pictured Rocks. We are currently refining existing techniques and exploring new techniques to address the need to conduct long-term monitoring of these species. Direct human conflict with most terrestrial vertebrates at the lakeshore is minimal. An exception is the black bear. We are currently revising the black bear management plan to better reflect recent developments in strategies to reduce conflict. As bears do not recognize political boundaries, we are writing this plan jointly with the Munising District of the Hiawatha National Forest with input from the MDNR. This collaboration will result in dissemination of consistent public information and management actions which should enhance our ability to minimize bear-human conflict.

Birds

Staff scientists are cooperating with NMU to characterize the forest avian community throughout the lakeshore. Two graduate students are conducting avian point counts at 300 biological monitoring plots located on a systematic grid during breeding season, late May-early July. One student will assess avian community structure at a macro (landscape) scale whereas the other student will evaluate micro scale (site-specific) vegetation characteristics on avian abundance. As with the mammal projects, probability of occurrence and abundance of birds will be modeled for the entire lakeshore. Structural components of vegetation important to breeding birds will be determined. In addition, a long-term protocol will be developed for monitoring forest bird abundance.

Abundance of Canada yew has declined in the upper Great Lakes region during the last 100 years. The effects of this decline on wildlife populations are largely unknown. A graduate student at Michigan Technological University is evaluating breeding bird and small mammal composition and abundance in areas containing yew in Pictured Rocks and other areas. He will determine which animal species use yew and how the change in abundance of yew may have affected wildlife populations in the Upper Peninsula.

Bald eagles have been used as a biological indicator of contaminant levels in the Great Lakes region for numerous years. Science staff continue to assist biologists from Clemson University and MDNR monitor bald eagle populations in Pictured Rocks. Two overflights are conducted annually to help determine nest occupancy and reproduction rates. Nest trees are climbed when young are 6-8 weeks old. Young are banded, measured, and feather and blood samples are taken for contaminant analyses. One young was produced in Pictured Rocks during 2002, a male at the Au Sable Point nest.

Vegetation Inventory and Monitoring

An understanding of landscape-scale vegetation community structure and status is important for natural resource planning, determining available habitat, and indicating potential impacts to habitat that may threaten viability of ecological communities. To assist with decision making, terrestrial communities within the shoreline and inland buffer zones of Pictured Rocks are being inventoried by lakeshore staff. This assessment intends to document the range and distribution of plant species and community types to spatially document habitat availability. Data collected will also indicate status of forest health, fuel loading, and extent of certain exotic plant species.

Vegetation crew at forest plot

Permanent sample locations (n=300) for long term bioligical monitoring were determined with assistance from North Central Forest Experimental Station staff and are nested within the National Forest Inventory and Analysis (FIA) sampling grid. Protocols for data collection within Pictured Rocks are compatible with national FIA standards so direct comparison with regional data is possible. This will allow for comparison of forest health indicators among protected forest land of Pictured Rocks, state forests, national forests, and private forest lands. Measurements at each plot include indicators for forest health, structure, growth, vegetative biodiversity, and abiotic parameters such as slope and aspect.

Lakeshore staff will be able to monitor temporal changes in forest composition as the previously logged-over areas of the shoreline zone re-establish old growth form and function. Assessment of inland buffer

zone forests will assist with determining whether this zone is protecting the natural processes of Pictured Rocks' ecosystems. Products from this work will include a new GIS forest cover map, additions to the verified vascular plant species list for the lakeshore, forest structure and plant diversity information for spatial modeling of habitat, and fuel loading information for fire management.

Exotic Plant Management

Populations of invasive exotic plants were mapped within the 2,000 acre Grand Sable Dunes Research Natural Area in 2000. Mapping was accomplished using a global positioning system. Efforts focused on two aggressive and prevalent exotic plant species, spotted knapweed (*Centaurea maculosa*) and red clover (*Trifolium pratense*). Populations of state listed Lake Huron tansy (*Tanacetum huronense*) and federally listed Pitcher's thistle (*Cirsium pitcherii*) were also mapped. This information is being used to develop an exotic plant removal and containment strategy for the dunes and for modeling occurrence and potential habitat for all mapped species. Modeling will guide monitoring efforts and assist Lakeshore staff and cooperators protecting coastal dune habitat.

Knapweed reduction in the dunes

In 2001 a work crew removed 48,499 spotted knapweed plants from 41 locations totaling 40 acres within the Grand Sable Dunes RNA. In 2002, 94,400 plants were removed from 8 locations totaling 32 acres. These crews received assistance from Youth Conservation Corps workers, other lakeshore employees, and Nature Conservancy volunteers. All plants were pulled or dug by hand using trowels and carried out of the dunes on frame backpacks. Areas targeted for treatment in 2001 and 2002 were predominantly metapopulations of knapweed spreading from major population centers towards the west and east ends of the dunes. Some work was initiated within the largest known knapweed population to protect pockets of Lake Huron tansy and Pitcher's thistle that were being completely overtaken. Additionally, 14 small populations of knapweed not previously mapped were identified and appeared to be recently established populations. These populations were mapped and treated immediately.

There are many estimates relating to annual seed production by spotted knapweed ranging from 349 - 18,000 seeds / plant and from 10,000 - 146,000 seeds / square meter. Using a conservative estimate of 1,000 seeds per plant, almost 143 million seeds were removed from the Grand Sable Dunes and as many as 2.5 billion seeds may have been removed based on the potential of 18,000 seeds per plant. Knapweed seeds retain a 30% germination rate after being buried in sand for 8 years indicating the necessity to return to treated areas annually for continued treatment and monitoring.

The goal remains to first contain exotic plant populations by treating outlying populations and use collected data to develop a plan of attack on the larger, well established populations. It seems probable that herbicide will need to be used in areas free of sensitive species to eradicate some larger populations of knapweed. No herbicide application is planned for 2003; future use will be carefully planned and implemented only where necessary.

There is no detailed research describing vegetation response to mechanical knapweed control. Most *Centaurea spp*. research has assessed the effectiveness of large-scale rangeland spray programs and biological control. Data collected in the Grand Sable Dunes RNA will be used to determine the effective-

ness of mechanical control on knapweed. This information will be useful for managers of small preserves, especially coastal dunes along the Great Lakes.

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